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Industrial automation systems and integration — Process specification language —

Part 13:
Duration and ordering theories

Systèmes d'automatisation industrielle et intégration — Langage de spécification de procédé —

Partie 13: Théories de classement et de durée

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 18629 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 18629-13 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC 4, *Industrial data*.

A complete list of parts of ISO 18629 is available from the Internet:

http://www.tc184-sc4.org/titles

Introduction

ISO 18629 is an International Standard for the computer-interpretable exchange of information related to manufacturing processes. Taken together, all the parts contained in the ISO 18629 Standard provide a generic language for describing a manufacturing process throughout the entire production process within the same industrial company or across several industrial sectors or companies, independently from any particular representation model. The nature of this language makes it suitable for sharing process information related to manufacturing during all the stages of a production process.

This part of ISO 18629 provides a description of the core elements of the language defined within ISO 18629.

All parts of ISO 18629 are independent of any specific process representation or model proposed in a software application in the domain of manufacturing management. Collectively, they provide a structural framework for improving the interoperability of these applications.

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Industrial automation systems and integration — Process specification language —

Part 13:
Duration and ordering theories

1 Scope

This part of ISO 18629 provides a representation of the primitive concepts related to ordering and durations constraints for activities.

The following is within the scope of this part of ISO 18629:

— subactivity occurrence orderings;

— duration;

— iterated occurrence orderings;

— occurrence tree endomorphisms;

— activity envelopes.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 8824-1: *Information technology — Abstract Syntax Notation One (ASN.1) — Part 1: Specification of basic notation.*

ISO 15531-1: *Industrial automation systems and integration — Industrial manufacturing management data — Part 1: General overview.*

ISO 18629-1: *Industrial automation systems and integration — Process specification language — Part 1: Overview and basic principles.*

ISO 18629-11: 2005, *Industrial automation systems and integration — Process specification language — Part 11: PSL-core.*

ISO 18629-12: *Industrial automation systems and integration — Process specification language — Part 12: Outer core.*

3 Terms, definitions, and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply:

3.1.1
automorphism
one-to-one mapping of elements on a set that preserves the relations and functions in some model

3.1.2
axiom
well-formed formula in a formal language that provides constraints on the interpretation of symbols in the lexicon of a language

[ISO 18629-1]

3.1.3
commutative group
algebraic structure with an internal binary operation (OP) with respect to which : a OP b = b OP a

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3.1.4
conservative definition
definition that specifies necessary and sufficient conditions that a term shall satisfy and that does not allow new inferences to be drawn from the theory

[ISO 18629-1]

3.1.5
core theory
set of axioms for relation and function symbols that denote primitive concepts

[ISO 18629-1]

3.1.6
defined lexicon
set of symbols in the non-logical lexicon which denote defined concepts

NOTE Defined lexicon is divided into constant, function and relation symbols.

EXAMPLE   terms with conservative definitions.

[ISO 18629-1]

3.1.7
endomorphism
mapping from a set onto a subset that preserves the relations and functions in some model

3.1.8
extension
augmentation of PSL-Core containing additional axioms

NOTE 1   The PSL-Core is a relatively simple set of axioms that is adequate for expressing a wide range of basic processes. However, more complex processes require expressive resources that exceed those of the PSL-Core. Rather than clutter the PSL-Core itself with every conceivable concept that might prove useful in describing one process or another, a variety of separate, modular extensions need to be developed and added to the PSL-Core as necessary. In this way a user can tailor the language precisely to suit his or her expressive needs.

NOTE 2   All extensions are core theories or definitional extensions.

[ISO 18629-1]

3.1.9
grammar
specification of how logical symbols and lexical terms can be combined to make well-formed formulae

[ISO 18629-1]

3.1.10
homomorphism
mapping between sets that preserves some relation on the elements of the set

3.1.11
interpretation
universe of discourse and assignment of truth values (TRUE or FALSE) to all sentences in a theory

NOTE   See annex B for an example of an interpretation.

[ISO 18629-11]

3.1.12
language
combination of a lexicon and a grammar

[ISO 18629-1]

3.1.13
lexicon
set of symbols and terms

NOTE The lexicon consists of logical symbols (such as Boolean connectives and quantifiers) and non-logical symbols. For ISO 18629, the non logical part of the lexicon consists of expressions (constants, function symbols, and relation symbols) chosen to represent the basic concepts of the ontology.

[ISO 18629-1]

3.1.14
model
combination of a set of elements and a truth assignment that satisfies all well-formed formulae in a theory

NOTE 1 The word "model" is used, in logic, in a way that differs from the way it is used in most scientific and everyday contexts: if a sentence is true in a certain interpretation, it is possible to say that the interpretation is a model of the sentence. The kind of semantics presented here is often called model-theoretical semantics.

NOTE 2   A model is typically represented as a set with some additional structure (partial ordering, lattice, or vector space). The model then defines meanings for the terminology and a notion of truth for sentences of the language in terms of this model. Given a model, the underlying set of axioms of the mathematical structures used in the set of axioms then becomes available as a basis for reasoning about the concepts intended by the terms of the language and their logical relationships, so that the set of models constitutes the formal semantics of the ontology.

[ISO 18629-1]

3.1.15
monomorphism
one to one mapping that preserves some relation on the elements of the set

3.1.16
ontology
lexicon of specialised terminology along with some specification of the meaning of terms in the lexicon

NOTE 1: structured set of related terms given with a specification of the meaning of the terms in a formal language. The specification of meaning explains why and how the terms are related and conditions how the set is partitioned and structured.

NOTE 2:   The primary component of a process specification language such as ISO 18629 is an ontology. The primitive concepts in the ontology according to ISO 18629 are adequate for describing basic manufacturing, engineering, and business processes.

NOTE 3:   The focus of an ontology is not only on terms, but also on their meaning. An arbitrary set of terms is included in the ontology, but these terms can only be shared if there is an agreement about their meaning. It is the intended semantics of the terms that is being shared, not simply the terms.

NOTE 4:   Any term used without an explicit definition is a possible source of ambiguity and confusion. The challenge for an ontology is that a framework is needed for making explicit the meaning of the terms within it. For the ISO 18629 ontology, it is necessary to provide a rigorous mathematical characterisation of process information as well as a precise expression of the basic logical properties of that information in the ISO 18629 language.

[ISO 18629-1]

3.1.17
Outer Core
set of core theories that are extensions of PSL-Core and that are so generic and pervasive in their applicability that they have been put apart

NOTE   In practice, extensions incorporate the axioms of the Outer Core.

[ISO 18629-1]

3.1.18
primitive concept
lexical term that has no conservative definition

[ISO 18629-1]

3.1.19
primitive lexicon
set of symbols in the non-logical lexicon which denote primitive concepts

NOTE Primitive lexicon is divided into constant, function and relation symbols.

[ISO 18629-1]

3.1.20
process
structured set of activities involving various enterprise entities, that is designed and organised for a given purpose

NOTE   The definition provided here is very close to that given in ISO 10303-49. Nevertheless ISO 15531 needs the notion of structured set of activities, without any predefined reference to the time or steps. In addition, from the point of view of flow management, some empty processes may be needed for a synchronisation purpose although they are not actually doing anything (ghost task).

[ISO 15531-1]

3.1.21
proof theory
set of theories and lexical elements necessary for the interpretation of the semantics of the language

NOTE   It consists of three components: the PSL-Core, the Outer Core and the extensions.

[ISO 18629-1]

3.1.22
PSL-Core
set of axioms for the concepts of activity, activity-occurrence, time-point, and object